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14. ABSTRACT

Throughout the 1970s and 1980s, the permanent seismic stations of the Soviet Union recorded over 100 Peaceful Nuclear Explosions (PNEs) detonated within the Soviet Union. These records have not been analyzed using modern digital methods and remain in Russian Archives. We have started a new initiative in collaboration with the Institute of Petroleum Geology and Geophysics (IPGG) of the Siberian Branch of the Russian Academy of Sciences (RAS) in Novosibirsk to assemble the records of these historic PNEs recorded at the permanent stations of the Russian regional networks. Most of these PNEs were detonated to conduct long-range Deep Seismic Sounding (DSS) profiles throughout much of the former Soviet Union in the 1970s and 1980s. The seismograms from the stations deployed for the DSS profiles are well known and continue to be studied. However, the seismograms from the permanent seismic stations have not been included in DSS studies. Collectively, there are several thousand records obtainable that will yield previously unused ray paths through the seismically more complex fold belts and accretionary zones, in particular in the Russian Far East beyond the eastern extent of the DSS profiles. We are collecting seismograms from the various seismogram archives in Russia, focusing initially on the Far East. The photopaper records are being scanned at high resolution (600 dpi) and then digitized and rectified. Test seismograms have been processed and have yielded good results. Record sections representing different geologic settings will be assembled to better understand crustal and velocity structure.

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ANALYSIS OF DIGITIZED SEISMOGRAMS FROM RUSSIAN GEOPHYSICAL SURVEY STATIONS OF SOVIET PEACEFUL NUCLEAR EXPLOSIONS

Kevin G. Mackey

Michigan State University

Sponsored by Air Force Research Laboratory

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ABSTRACT

Throughout the 1970s and 1980s, the permanent seismic stations of the Soviet Union recorded over 100 Peaceful Nuclear Explosions (PNEs) detonated within the Soviet Union. These records have not been analyzed using modern digital methods and remain in Russian Archives. We have started a new initiative in collaboration with the Institute of Petroleum Geology and Geophysics (IPGG) of the Siberian Branch of the Russian Academy of Sciences (RAS) in Novosibirsk to assemble the records of these historic PNEs recorded at the permanent stations of the Russian regional networks. Most of these PNEs were detonated to conduct long-range Deep Seismic Sounding (DSS) profiles throughout much of the former Soviet Union in the 1970s and 1980s. The seismograms from the stations deployed for the DSS profiles are well known and continue to be studied. However, the seismograms from the permanent seismic stations have not been included in DSS studies. Collectively, there are several thousand records obtainable that will yield previously unused ray paths through the seismically more complex fold belts and accretionary zones, in particular in the Russian Far East beyond the eastern extent of the DSS profiles. We are collecting seismograms from the various seismogram archives in Russia, focusing initially on the Far East. The photopaper records are being scanned at high resolution (600 dpi) and then digitized and rectified. Test seismograms have been processed and have yielded good results. Record sections representing different geologic settings will be assembled to better understand crustal and velocity structure.

OBJECTIVES

This study seeks to obtain, scan, digitize, and analyze seismograms from Soviet permanent seismic station networks of Soviet Peaceful Nuclear Explosions (PNEs). The analysis seeks to better resolve the crustal and velocity structure of Russia, particularly the Russian Far East where Deep Seismic Sounding (DSS) profiles using the PNEs were not conducted.

RESEARCH ACCOMPLISHED

Long-range DSS profiles were conducted in the Soviet Union from 1971 to 1988 using PNEs (Figure 1) as sources (e.g., Benz et al., 1992). These profiles have been extensively analyzed using the original profile data both in Russia (e.g., Belousov et al., 1991) and more recently reprocessed in the west (e.g., Morozov et al., 2005). These PNEs were recorded using instruments deployed along the profiles at distances of 100–200 km spacing. These PNE profiles have been used to study a wide range of seismological phenomena, including attenuation, lithospheric and upper mantle structure, and scattering (e.g., Egorkin et al., 1987). Given that most of the PNEs were detonated in stable, cratonic areas, while the regional networks were located in the seismically active periphery, study of the PNEs recorded at the regional network stations will add a great number of previously unused ray paths through the seismically more complex fold belts and accretionary zones, in particular in eastern Russia and along the Russian border with China.

These PNEs were recorded at analog seismic stations operated by the regional networks resulting in over 7,800 seismograms (GS RAS, 2001) from the permanent Russian seismic stations. Only one systematic study (GS RAS, 2001) has been conducted with these records, basically consisting of P- and S-phase time picks for calibrating Russian Geophysical stations for Comprehensive Nuclear-Test-Ban Treaty (CTBT) monitoring. Although broad in scope, the study did not include any waveform analysis. Many seismograms were digitally scanned but are of poor quality and low resolution and thus of little use beyond the picking of basic arrival times. The study did not address stations in the former Soviet republics besides Russia.

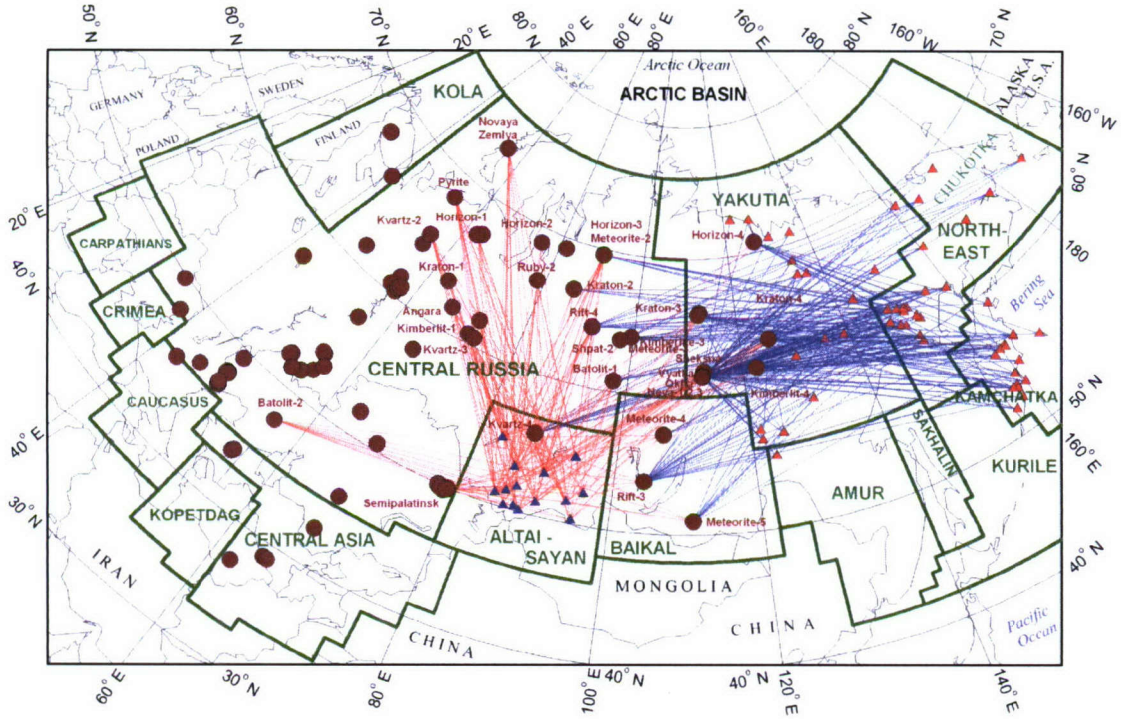
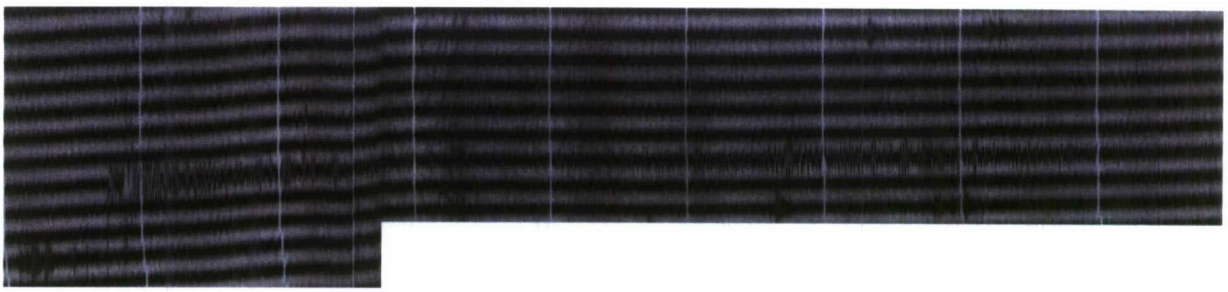
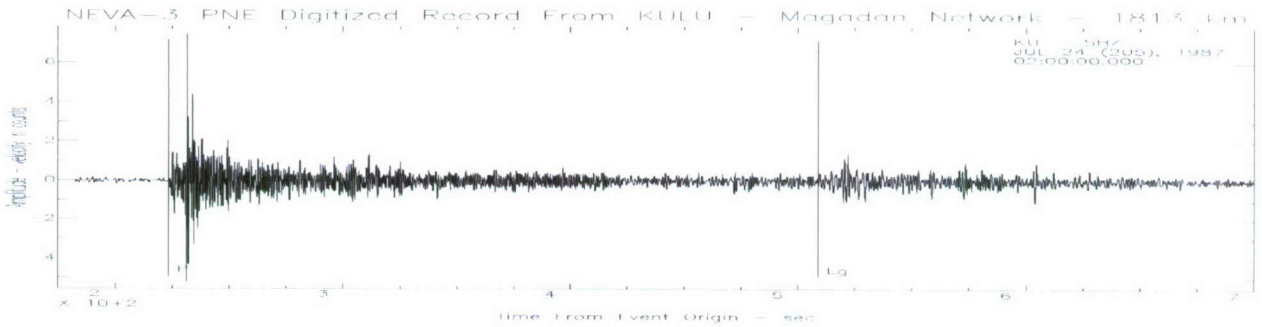


Figure 1. Current status of PNE seismograms collected by the joint Michigan State University (MSU)-Novosibirsk digitization and analysis project. Blue lines are paths of MSU's current holdings. and red lines are Novosibirsks holdings of high-resolution scans of PNE recordings at geophysical stations (triangles). PNEs are denoted by red circles.

We recently began working with the seismology group at IPGG to begin assembling, digitizing, and analyzing records from the regional networks of Russia. Figure 1 shows the raypaths of seismograms already scanned or




NEVA—.3 PNE Digitized Record From KULU — Magadan Network — 181.3 km
KU SHZ
JUL 24 (205), 1987
02:00:00.000
P
Lg
X 10+2
Time From Event Origin — sec